CLAIMS

1.   A method for determining a vehicle trip on a roadway, the method comprising:

     providing a plurality of vehicle detections from a plurality of gateways;

     determining a maximum travel time between corresponding pairs of the plurality of gateways;

     correlating corresponding pairs of the plurality of vehicle detections by determining that a travel time between each of the gateways of each of the corresponding pairs of detections is less than a corresponding maximum travel time;

     determining a plurality of chainable detections; and

     determining the boundaries of the trip.

2.   The method of claim 1 wherein providing the plurality of vehicle detections comprises providing at least one license plate image corresponding to one of the plurality of vehicle detections.

3.   The method of claim 2 further comprising:

     determining a vehicle license plate number; and

     processing the at least one license plate image for verifying the vehicle license plate number

4.   The method of claim 1 wherein providing the plurality of vehicle detections comprises filtering a plurality of vehicle transactions for providing the plurality of vehicle detections.

5.   The method of claim 4 wherein the plurality of vehicle transactions includes at least one ambiguous transaction; and

     further comprising eliminating at least one ambiguous transaction from the plurality of vehicle transactions.

6.   The method of claim 5 wherein the at least one ambiguous transaction includes a conflicting gateway crossing.

1   7.   The method of claim 4 further comprising eliminating dual transactions from the

2   plurality of vehicle detections.

1   8.   The method of claim 1 wherein correlating the corresponding pair of the plurality

2   of vehicle detections further comprises determining whether each of the pair of detections

3   is provided by a corresponding pair of gateways that are disposed logically consistent

4   with the roadway topology.

1   9.   The method of claim 1 wherein correlating the corresponding pair of the plurality

2   of vehicle detections further comprises determining that the travel time between each of

3   the detections is greater than a minimum travel time.

1   10.   The method of claim 1 wherein determining a maximum travel time comprises

2   determining an incident free maximum travel time.

1   11.   The method of claim 10 further comprising:

2   determining an expected travel time; and

3   determining that the maximum travel time is the longer of the expected travel

4   time and the incident free maximum travel time.

1   12.   The method of claim 11 further comprising:

2   detecting a traffic incident; and

3   modifying the expected travel time in response to the traffic incident.

1   13.   The method of claim 1 further comprising waiting for the plurality of chainable

2   detections to be initially processed.

1   14.   The method of claim 1 further comprising waiting for the plurality of chainable

2   detections to be verified.

1   15.   The method of claim 13 further comprising determining a latest time for the

2   plurality of detections.

1   16.   The method of claim 1 wherein determining the boundaries comprises detecting

2   the end of the trip.

1   17.   The method of claim 16 wherein detecting the end of the trip comprises:

2   determining a maximum detection time for the plurality of chainable detections;

3   determining a current boundary time;

4   comparing the current boundary time to the maximum detection time; and

5   declaring the end of the trip in response to determining that the current boundary

6   time is greater than the maximum detection time.

1   18.   The method of claim 1 wherein determining the boundaries comprises detecting

2   the start of the trip.

1   19.   The method of claim 1 further comprising forming the trip by chaining the

2   plurality of chainable detections.

1   20.   The method of claim 1 further comprising waiting for the plurality of chainable

2   detections.

1   21.   The method of claim 20 wherein waiting for all detections that might chain

2   comprises:

3   determining a first time wherein each of the plurality of chainable detections has a

4   first extrapolation region terminating earlier than the first time.

1   22.   The method of claim 21 further comprising:

2   determining a second time wherein each of the plurality of chainable detections

3   occurring later than the first time has a second extrapolation region terminating earlier

4   than the second time, is evaluated for verifying.

1   23.   The method of claim 22 verifying transactions occurring between the first time

2   interval and the second interval time using a video image of a license plate number

3   captured at the time of the detection.

1   24.   The method of claim 22 wherein verifying transactions comprises automatically

2   recognizing the license plate number from the image.

1   25.   The method of claim 22 wherein verifying transactions comprises manually

2   reading the license plate number from the image.

1   26.   The method of claim 1 wherein the plurality of vehicle transactions is provided by

2   at least one of:

3   an enforcement gateway; and

4   a toll gateway sensor.

1   27.   The method of claim 1 wherein each of the plurality of vehicle detections

2   comprises:

3   a time of the detection; and

4   the location of the detection.

1   28.   The method of claim 1 wherein determining the boundaries of the trip comprises

2   using at least one of:

3   a traffic incident; and

4   a set of billing policies.

1   29.   A method for determining a vehicle trip on a roadway having a plurality of

2   gateways disposed according to a roadway topology, the method comprising:

3   providing a model of the topology including gateway connectivity, a plurality of

4   minimum travel times between pairs of gateways, and a plurality of incident free

5   maximum travel times between pairs of gateways;

6   providing a plurality of vehicle detections;

7   providing a set of rules for applying the model;
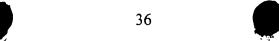
8   correlating the plurality of vehicle detections by applying the rules to the plurality

9   of vehicle detections; and

10   determining a plurality of chainable vehicle detections forming the trip.

1   30.   The method of claim 29 further comprising determining a plurality of expected

2   travel times between the pairs of gateways.

1 31.   The method of claim 30 further comprising chaining the plurality of chainable
2 vehicle detections for forming a potential trip.

1 32.   The method of claim 31 further comprising verifying a license plate reading
2 corresponding to at least one of the plurality of chainable vehicle detections.

1 33.   The method of claim 32 further comprising waiting for required verification of at
2 least one of the plurality of chainable vehicle detections in the potential trip; and
3   chaining the plurality of chainable vehicle detections to form the trip.

1 34.   A toll collection system comprising:
2   a plurality of gateways;
3   a trip determination processor comprising:
4   a transaction processor;
5   a vehicle detection correlation processor coupled to the transaction
6 processor;
7   a transaction filter processor coupled to the vehicle detection correlation
8 processor;
9   an end of a trip detection processor coupled to the transaction filter
10 processor;
11   a start of a trip detection processor coupled to the transaction filter
12 processor; and
13   a trip formation processor coupled to the transaction filter processor, the
14 end of a trip detection processor, and the start of a trip detection processor.

1 35.   The system of claim 34 wherein the plurality of gateway is adapted for an open
2 ticket tolling system.

1 36.   The system of claim 34 wherein the plurality of gateway is adapted for a closed
2 ticket tolling system.

1 37.   The system of claim 34 wherein the plurality of gateway is adapted for an open
2 ticket enforcement system.

1   38.   The system of claim 34 wherein the plurality of gateway is adapted for a mixed open

2   ticket, closed ticket tolling system.